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Rise to fame: events, media activity and public interest in pangolins and pangolin trade, 2005–2016

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Abstract

Attention focused on pangolins (Pholidota) and the threats posed to their survival and welfare by international trade (for use in Chinese Traditional Medicine and the Asian wild meat market) has skyrocketed across all digital information platforms over the last decade. Previously obscure and often referred to as the 'mammal you've never heard of', pangolins are now widely recognised as an icon of the illegal wildlife trade. We document the events that led to the pangolins' 'rise to fame', culminating in its Appendix I listing by CITES in September 2016 and a global commercial trade ban and explore temporal co-occurrence between events and peaks in media activity and public interest with the aim of identifying events (or types of events) that may have been influential in terms of awareness-raising. More broadly, our objective was to highlight lessons in public communication that might be applied to awareness campaigns for other lesser-known threatened species. We found no evidence that any particular type of event was more likely to generate a significant media/public response than any other, but peaks in public interest co-occurred with reports of pangolin seizures, highlighting the importance of news coverage of these incidents. Further, although neither editorial nor social media peaks were strongly correlated with the timing of events, they sometimes co-occurred with different events and each differed in their coverage of different types of events, suggesting that editorial and social media have independent and distinct roles to play in conservation communication. However, despite their iconic status, public interest in pangolins is still not equivalent to that directed at, for example, tigers, elephants or lions, so efforts need to be sustained. Finally, we note that, although attention can help to generate funds and influence policy, this alone will not be enough to achieve a favourable conservation status for pangolins – on-going and future work need to ensure that public enthusiasm for this species is translated into effective protection.

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Keywords
Awareness, Facebook, Google trends, news, wildlife trade

Introduction

Public awareness of conservation and animal welfare issues at a global level can be hugely important in instigating, driving and supporting remedial action, largely through influences on policy change and funding (e.g. Lindemann-Matthies and Bose 2008, Tisdell 2006, Phillis et al. 2013, Wright et al. 2015). However, for some species, (particularly those not often seen in the wild, in zoos, sanctuaries or on television), the general public can be oblivious to the threats that they face. Ten years ago, this was true of pangolins for much of the public in the Western world (predominantly English-speaking countries in, for example, Europe and North America). Initially referred to in the media as the 'mammal you've never heard of' (e.g. Sutter 2014), pangolins are now widely portrayed as an icon of the illegal wildlife trade alongside the well-known 'charismatic megafauna' (elephants and rhinos) and their highly-publicised trade issues (poaching for ivory and rhino horn, respectively; e.g. Gao and Clark 2014, Haas and Ferreira 2016).

The precise mechanism underlying this 'rise to fame' is not well understood. Yet, whilst others have documented the conservation actions undertaken (e.g. Challender et al. 2012, 2014a, 2015, 2016) and the patterns of pangolin trade (e.g. Challender and Hywood 2012, Heinrich et al. 2016, 2017), there has been no comparable assessment of either the media or public response to this series of 'events'. By 'events' we mean here an action or incident concerning, or relevant to, pangolins, their conservation or trade. Events might, therefore, include public education campaigns run by NGOs that are designed specifically to raise awareness, but also conservation actions (by, for example, governments, government agencies or inter-governmental organisations) and/or trade-related incidents (such as animals poached, products [animals or their parts] seized or poachers/traffickers arrested), either of which may be covered in the news and thus picked up (directly or via social media) by the general public. Conservation actions may also be publicised directly online via group websites and Facebook pages. Media and/or public attention to such events varies and is not always predictable, but can be considerable. For example, the killing of 'Cecil the lion' in Hwange National Park, Zimbabawe, in 2015, was mentioned in almost 12,000 news articles and over 87,000 social media posts in a single day, largely (but not entirely) due to 'impassioned criticism' of the event by a popular US TV talk show host, although Cecil was not the only lion to have been hunted in Hwange either before or after this event (Macdonald et al. 2016).

Understanding of the types of events that are likely to be influential or to generate considerable public interest, would allow more efficient targeting of sustained awareness-raising strategies specifically for pangolins and, more broadly, would have benefits for conservation marketing for other similar little-known species where greater public awareness of their threats might be helpful. As a first step in this process, here

we document and quantify 12 years of pangolin trade-related events and associated media activity and public interest. We hypothesised that there would be an underlying increase in the activity of all types of media and in public interest, related to pangolins and their trade, over this period. However, our specific focus in this analysis was to identify peaks in activity/interest and to explore temporal correlations amongst them and amongst media peaks and peaks in public interest and the occurrence of events. Our aim was to identify events, or types of events, that generated or attracted most public or media interest. Ultimately, our objective was to identify general patterns that could be applied to awareness-raising strategies targeted at similarly little-known threatened animal species.

Pangolins and their trade

There are eight species of pangolin (Order Pholidota, also known as 'scaly anteaters') that collectively range across Asia (where there are four *Manis* spp.) and Africa (where there are two *Phataginus* spp. and two *Smutsia* spp.; Hassanin et al. 2015). All eight species are listed by CITES as *Manis*. All pangolin species are unique amongst mammals in being covered in keratin scales, and all are traded, domestically and internationally, for their scales and their meat (UNODC 2016). Pangolin meat is consumed in Africa and Asia, and is considered a delicacy in many parts of China where it is available in high-end restaurants and desired because it is rare, wild, expensive and illegal and because of the status that it is perceived to impart on consumers (Challender et al. 2015). Their scales are sought after for use in traditional medicine in both Africa (particularly West Africa, see Boakye et al. 2015) and Asia (see Zhou et al. 2014) for their perceived effects in treating a range of physical and spiritual conditions (Challender et al. 2015). Pangolins (body mass 2–33 kg, depending on the species) are solitary, nocturnal, insectivorous mammals that exist almost entirely on ants and termites that they eat with their elongated tongues (Macdonald et al. 2004). They occur at low population densities (estimates of 0.2–1.0 individuals per km^2, Mahmood et al. 2014, Pietersen et al. 2014a) and reproduce slowly (usually giving birth to a single young once a year (Mahmood et al. 2015, Zhang et al. 2016) – life history characteristics that render them vulnerable to overexploitation (e.g. Sodhi et al. 2009). Commercial trade in wild-caught Asian pangolins has been illegal since 2000 (under a CITES zero export quota, Challender et al. 2015) and is now illegal for all pangolin species. Nevertheless, illicit trade in the period 2000 to 2013 is estimated to have involved over a million individual pangolins (IUCN PSG 2016, Heinrich et al. 2017), most of which were destined for China and Vietnam (UNODC 2016). Of the four Asian species, the Chinese pangolin (*M. pentadactyla*) and the Sunda pangolin (*M. javanica*) are Critically Endangered, the two other Asian species are Endangered and the four African species are Vulnerable (IUCN 2018). Hunting and poaching for trade is considered the greatest threat to the survival of all pangolin species (Baillie et al. 2014, Challender et al. 2014b, c, Lagrada et al. 2014, Pietersen et al. 2014b, Waterman et al. 2014a, b, c).

Methods

To provide a context for the analysis, we first described broadly the chronology of events associated with pangolin conservation and trade, beginning with the formation of SavePangolins.org in 2007 and culminating, in September 2016, with the voting of parties at the CITES CoP 17 (Convention of International Trade of Endangered Species of Wild Fauna and Flora, Conference of Parties) to list all eight species of pangolin under Appendix I, thus affording them the highest level of protection under the treaty. We then quantified patterns and trends in the volume of social and editorial media activity related to pangolins and their trade and in relative public interest in pangolins generally, between 2005 and 2016 (covering two years prior to the first prominent event). To quantify relative public interest, we used Google Trends data, which provides a measure of relative Google search activity associated with a specified keyword. The use of Google Trends in this context is well-established (Proulx et al. 2014) and has been used to gauge public awareness and interest in a number of other conservation contexts (e.g. Do et al. 2014, Kim et al. 2014, Nghiem et al. 2016, Soriano-Redondo et al. 2016, Braczkowski et al. 2018). Finally, we used outlier detection in time series analysis to identify (1) monthly peaks in public interest, 2005–2016 and (2) daily peaks in social and editorial media activity and weekly peaks in public interest, 2015–2016 and, for both, assessed temporal co-occurrence amongst datasets and with events. For the latter, we focused specifically on the final two years because this was a period when both events and media activity appeared to be particularly intense. The difference in resolution between datasets was due to limitations associated with Google Trends data.

Identification of events

Key events, related to pangolins and/or pangolin trade, were identified on the basis of personal observation (NC) and personal communication with pangolin experts, with additional events obtained from Challender et al. (2015), the Pangolin Specialist group website (https://www.pangolinsg.org), the WildAid website (a trade-related NGO known for their high-impact media campaigns, wildaid.org) and a Google (https://www.google.com) search for 'pangolin trade'. YouTube (http://www.youtube.com) was also searched for videos on pangolin trade and seizure data were obtained from the Pangolin Crime Dataset 2000–2017 (a dataset of poaching and seizure incidents derived from publicly available sources primarily in Chinese and English languages) held by the Environmental Investigation Agency (EIA) UK (https://eia-international.org/illegal-trade-seizures-pangolins). All events occurring between 2005 and 2016 were collated and categorised as governmental or inter-governmental, non-governmental, media/celebrity events, seizures or 'other' (e.g. zoo-related events). Online publication of a YouTube video was included as an event if the video received >10,000 views (the criteria used by YouTube for their partnership programme that allows users to carry adverts, BBC 2017). Seizures were defined as 'major' seizures and included as events, when the number of

whole pangolins seized exceeded 1,000 individuals (or 4,000 kg where only total weight was reported; based on approximate equivalence indicated in the database where both number of individuals and total weight was given) or the weight of scales seized exceeded 3,000 kg (representing between 3,000 and 6,000 individuals based on an estimated 0.5–1.0 kg of scales per animal, depending on species, Choudhary et al. 2018). Our intention for including major seizures as events was not to describe trends in either trade or seizures (which has been covered adequately elsewhere, Heinrich et al. 2017), but to include a subset of the largest seizures on the basis that these were probably the most likely to have generated media coverage and thus public interest. The precise definition of a major seizure was somewhat arbitrary, but represented the top 2% of seizures (in terms of size) in the EIA database.

Social media activity

To quantify social media activity, we used Facebook (www.facebook.com, hereafter FB) as an indicator of social media rather than attempting to quantify all social media activity across multiple platforms. Although other social media platforms are reportedly gaining increasing popularity, especially amongst the younger generation (e.g. Instagram, WhatsApp), FB currently has the most active users worldwide of all social network sites (> 2 billion as of September 2017, Statista 2017) and in a recent survey was rated as the most popular social media platform for nature-related posts (Di Minin et al. 2015). We used the search term 'pangolin wildlife trade' and manually collated data on all posts to include date, original poster and reactions to posts (number of 'likes', comments and 'shares'). Number of posts (and number of 'new' posts, i.e. posts by individuals or organisations that had not posted on this subject previously), reactions to posts and total number of active FB users (from Statista 2017) were quantified per year from 2005 to 2016 (FB was launched in 2004) to provide a general overview of trends over a longer time period. The number of posts was also quantified per day for 2015–2016 to provide a more detailed exploration of the temporal links between social media activity, peaks in editorial media or public interest and the occurrence of events.

Editorial media

Traditional editorial media articles were obtained from Nexis UK (http://www.nexis.com), a 'media news' research service, licensed by LexisNexis for the academic market, covering global sources of news (including newspapers, newswires, blogs, reports and trade journals). We searched for all primary articles (where the search term – 'pangolin' – appeared in the headline or first paragraph), in all news held by Nexis UK, in all languages, published between 2005 and 2016. We manually screened any articles that did not contain the word 'pangolin' in the title prior to inclusion and included articles that focused specifically on pangolins or their conservation, but excluded those about

wildlife trade or biodiversity generally that only mentioned pangolins in a list of other species. For comparability with social media data, we recorded the number of news articles (including the same articles published in different outlets to give an indication of the extent of news coverage) per year from 2005–2016 and per day from 2015–2016.

Public interest

We used Google Trends (hereafter GT) to obtain data on Google-based web searches for 'pangolins' (animal) as a topic (which automatically includes alternative forms of the search term), across the internet (web search), in all categories, worldwide, at a monthly resolution for 2005–2016 and separately (at a weekly resolution) for 2015–2016 (daily resolution data were not available). GT does not provide absolute counts of google searches, but gives relative search volume which represents searches relative to the peak in searches (arbitrarily assigned a value of 100) within the region and time period of interest (i.e. a value of 50 means that the term at that point in time was half as popular as at the peak) and is routinely corrected for the total number of web queries (Proulx et al. 2014). We also extracted data on the number of page views of Wikipedia's (en.wikipedia.org) pangolin page. Wikipedia page views have the advantage, compared with GT, of (1) being clearly indicative of people seeking information on pangolins (as opposed to, for example, potential confusion with people searching for 'Precise Pangolin', a computer operating system launched in 2012), (2) providing data on actual (rather than relative) number of page views and (3) providing data at daily resolution (Kämpt et al. 2015). Wikipedia page views were only available from July 2015 – we therefore used GT to obtain longer-term data on public interest but also used Wikipedia page views to verify and to further explore in finer detail, temporal patterns in public interest that occurred in the latter half of 2015 and in 2016.

Time series analysis

All statistical analyses were carried out in R (version 3.4.3, R Core Team 2017). To identify peaks in time series, statistical outliers were detected (in monthly GT data, 2005–2016 and in daily news articles, FB posts and weekly GT data, 2015–2016) using the tso function in the tsoutliers package (Lopez-de-Lacalle 2017) and peaks defined as positive, non-consecutive, statistical outliers of type AO (Additive Outlier, a single spike in the data) or TC (Temporary Change, a sudden increase followed by a gradual decline to baseline values). LS (Level Shift) outliers were also identified separately using the same function to identify points at which an overall increase in baseline activity occurred. Dates of peaks were extracted manually using the timestamps generated and temporal co-occurrence with dates of events recorded. For daily news articles and FB posts, the dates of daily peaks were used to generate binary time series and correlations between them assessed using the Ccf function in the forecast package (Hyndman 2017). Associations between media type, events and event type and the likelihood of co-occurring with peaks in interest,

were tested using chi-squared tests or Fisher's exact test, as appropriate. For monthly GT, underlying trends in the data were described using the tslm function (also in the forecast package) and points at which trends changed identified using the breakpoints function in the struccchange package (Zeileis et al. 2002). We did not assess trends in media activity between 2005 and 2016 because, at an annual resolution, the dataset was too small for time series analysis. We also did not assess trends in the 2015–2016 data because the time period was short and we were primarily interested in peaks in the data.

Results

Chronology of events

Following the formation of SavePangolins.org in 2007, February 2012 saw the re-establishment of the IUCN Pangolin Specialist Group (PSG) and the first World Pangolin Day. Within this period (2007–2012), there were three key events, all of which involved conservation professionals: a TRAFFIC workshop in 2008, a CITES alert sent to Parties in 2010 and the formation of the African Working Group (preceding the IUCN PSG) in 2011. In addition, a rescued pangolin (later named 'Baba') was brought to San Diego zoo in 2007 and David Attenborough (a well-known naturalist TV presenter) named pangolins amongst his list of ten species that he would most like to 'save from extinction' in 2012. This was followed, through 2013 and 2014, by a number of events led by the IUCN, including the first international PSG conservation conference, publication of the updated pangolin Red List assessments and the launch of the IUCN Pangolin Action Plan. The first significant media event, where pangolins were featured for a week in a popular online game ('Angry Birds Friends', played by 200 million people worldwide), occurred in November 2014. The event was supported (in an online video interview) by Prince William in his role as president for United for Wildlife (Styles 2014). Pangolins also featured at the 2014 Montier-en-der film festival in a short film entitled 'Plight of the Pangolins'.

The number of pangolin-related events increased notably in 2015 and 2016. Events, at this time, initially involved predominantly governmental and non-governmental actions, including the formation of a trade coalition, the first pangolin range states meeting, a petition to list pangolins on the US Fish and Wildlife Endangered Species Act and an IUCN Resolution to provide greater protection for all pangolin species. From October 2015, there appeared to be an increasing media/celebrity involvement, beginning with the creation of the social media character 'Ollie the Pangolin' and including (through 2016) the appearance of a pangolin in the Disney movie 'The Jungle Book', the involvement of national celebrities in media campaigns in China and Vietnam, an event supported by Jane Goodall and a number of awareness-raising materials published online (e.g. the WildAid video infographic 'The Fight to Save Pangolins' and the National Geographic short video 'The Tragic Tale of a Pangolin'). In total, we identified 16 (non-seizure) key events between 2005 and 2014 and 26 in 2015 and 2016. Further details, additional events and references are given in Table 1.

Table 1. Pangolin-related events occurring between 2005 and 2016. Type of event coded as: governmental/intergovernmental G/IG, non-governmental NG, media/celebrity M, major seizures S, or 'other' (e.g. zoo-related events) O; YouTube videos were included as media events if they received ≥10K views (see text); seizures were defined as major seizures if they exceeded 1,000 whole pangolins (equivalent to c. 4,000 kg where weight of the seizure rather than numbers was given) or 3,000 kg pangolin scales (see text, this represents the top 2% of seizures in the source database). 2015–2016 events associated with peaks in editorial (marked as **N**) or social (**FB**) media, or with weekly GT peaks (**wGT**), are indicated in square brackets. (Note that the content of both news articles and Facebook posts suggest that the media peak on 5th October – see text – coinciding with publication of a YouTube video, was actually related to coverage of the CITES listing that occurred 7 days earlier – and that news coverage of this event continued until at least the 13th October 2016.)

Event	Date/Year	Type	Source [media/interest peak, shown for 2015–2016]
Hoi Ha Wan seizure of 1,800 whole pangolins, Hong Kong	2005	S	EIA database[11]
SavePangolins.org formed	2007	NG	www.savepangolins.org
'Baba' brought to San Diego Zoo[1]	2007	O	www.sandiegouniontribune.com/news/whats-now/sd-me-pangolin-dies-20160930-story.html
Seizure of whole pangolins (weight 21,000 kg) and 900 kg scales, Hai Phong, Vietnam	Mar 2008	S	EIA database[11]
Pangolin workshop in Singapore[2]	30th Jun-2nd Jul 2008	NG	Pantel and Chin 2009
Seizure of whole pangolins (weight 13,800 kg), Palembang, Indonesia	Aug 2008	S	EIA database[11]
Gaolan Island, Guangdong, seizure of 2,090 whole pangolins, China	13th Jul 2010	S	EIA database[11]
CITES alert sent to Parties[3]	2010	G/IG	Challender et al. 2015
African Pangolin Working Group (APWG) formed	27th Jun 2011	NG	www.africanpangolin.org/
Seizure of whole pangolins (weight 7,500 kg) and 65 kg scales, Tanjung Priok, Indonesia	26th May 2011	S	EIA database[11]
Seizure of 1,068 whole pangolins, Malaysia	7th Dec 2011	S	EIA database[11]
IUCN Pangolin Specialist Group (PSG) re-established	Feb 2012	G/IG	www.pangolinsg.org/about/
First World Pangolin Day	Feb 2012	NG*	www.pangolins.org/about-us/
INTERPOL Operation Libra[4]	Jun/Jul 2012	S	EIA database[7]; www.interpol.int/News-and-media/News/2012/N20120829
IUCN Pangolin SG website launched	17th Sept 2012	G/IG	www.pangolinsg.org/2012/06/14/hello-world-2/
Pangolin included in David Attenboroughs' ten favourite species	Nov 2012	M	www.telegraph.co.uk/news/9637972/Sir-David-Attenborough-picks-10-animals-he-would-take-on-his-ark.html
Huilai County seizure of 2,032 whole pangolins and 325 kg pangolin scales, China	23rd Dec 2012	S	EIA database[11]
YouTube 'Meet the Pangolin!' video published (22K views)	15th Feb 2013	M	www.youtube.com (uploaded by Annamiticus)
Seizure of whole pangolins (weight 10,000 kg), Tubbataha NP, Palawan, Phillippines	8th Apr 2013	S	EIA database[11]
1st International PSG conservation conference	Jun 2013	G/IG	portals.iucn.org/library/node/44947
Seizure of whole pangolins (weight 15,140 kg) and 990 kg scales, Hai Phong, Vietnam	Aug 2013	S	EIA database[11]
YouTube Born to be Wild video 'Doc Nielsen exposes the illegal pangolin trade' published (34K views)	4th Apr 2014	M	www.youtube.com (uploaded by GMA Public Affairs)
IUCN news release, Red List assessments published, launch of Action Plan	Jul 2014	G/IG	www.iucn.org/content/eating-pangolins-extinction; http://www.iucnredlist.org/; portals.iucn.org/library/node/44947
Range States requested to submit information on illegal trade at CoP16	Jul 2014	G/IG	Challender et al. 2015

Event	Date/Year	Type	Source [media/interest peak, shown for 2015–2016]
Pangolins featured in Angry Birds Friends[5]	Nov 2014	M	www.angrybirdsnest.com/angry-birds-friends-pangolins-tournament-on-now/
Plight of the Pangolins at Montier-en-Der film festival	Nov 2014	M	www.annamiticus.com/2014/11/28/french-wildlife-photography-festival-backs-pangolin-conservation/
Anti-pangolin poaching Public Service Announcement aired in Vietnam[6]	29th Jan 2015	M/NG	www.edition.cnn.com/2015/01/29/opinion/sutter-pangolin-psa-vietnam/index.html
Pangolin workshop in Brunei (sponsored by the British High Commission)[7]	16th-21st Feb 2015	G/IG	www.gov.uk/government/news/british-carnivore-and-pangolin-conservationist-to-support-bruneis-wildlife-conservation-efforts
World Pangolin Day 2015	21st Feb 2015	NG/M	**[FB]**
YouTube 'March of the Pangolins' video published (11K views)	6th Mar 2015	M	www.youtube.com (uploaded by WildAid)
Medan warehouse raid, seizure of 3,000-4,000 frozen pangolins, Indonesia	23rd Apr 2015	S	EIA database[11] **[wGT, see Fig. 2a]**
1st Pangolin Range States meeting	24th-26th Jun 2015	G/IG	www.fws.gov/news/blog/index.cfm/2015/7/2/Pangolins-Benefit-as-United-States-Range-States-Gather-to-Plan-Critical-Conservation
SOS and Foundation Segre announce International Pangolin Conservation Initiative	26th Jun 2015	NG	www.saveourspecies.org/news/sos-and-fondation-segre-announce-new-international-pangolin-conservation-initiative
NGOs petition USFWS to protect 7 pangolin species under the Endangered Species Act (ESA)	15th Jul 2015	NG	www.thepetitionsite.com/en-gb/790/993/022/usfws-%E2%80%93-list-the-seven-endangered-pangolin-species-not-protected-under-esa/; https://www.regulations.gov/docket?D=FWS-HQ-ES-2016-0012 **[N]**
4,000 kg of pangolin scales seized in Central Danang's Tien Sa port, Vietnam	25th Aug 2015	S	EIA database[11]
Ollie the pangolin facebook page created	9th Oct 2015	M	www.facebook.com/pg/olliethepangolin/about/?ref=page_internal
1st International APWG conference	12th – 15th Oct 2015	NG	www.paxtag.org/international-pangolin-conference-12-15-oct-2015-south-africa/
Jiangmen seizure of 2,674 whole pangolins, China	3rd Nov 2015	S	EIA database[11] **[associated with a monthly GT peak, see Fig. 2a]**
YouTube 'Guardians of the Pangolin: the fight to save the world's most trafficked animal' video published (17K views)	17th Nov 2015	M	www.youtube.com (uploaded by Coconuts TV)
WildAid video infographic (The Fight to Save Pangolins)	18th Feb 2016	NG	www.vimeo.com/155919419
World Pangolin Day 2016	20th Feb 2016	NG/M	**[N, FB]**
USFWS announce (substantial) 90-day findings for the petition to list all pangolins under the ESA[8]	15th Mar 2016	G/IG	www.eei.org/Lists/Articles/DispForm.aspx?ID=7970; www.gpo.gov/fdsys/pkg/FR-2016-03-16/pdf/2016-05699.pdf
Pangolin character in 'The Wild Life' (Robinson Crusoe movie) (trailer released)	15th Mar 2016	M	www.youtube.com/watch?v=3dyAWBMF6bE
Pangolin in Disney movie The Jungle Book	15th Apr 2016	M	www.romper.com/p/theres-a-pangolin-in-the-jungle-book-everyone-is-freaking-out-9020; www.huffingtonpost.com/jeffrey-flocken/ifaw-qa-with-the-jungle-b_b_10109890.html
WildAid and the Nature Conservancy China feature Angelababy in media campaign (say no to pangolin products)	20th May 2016	M	www.wildaid.org/news **[FB]**
4 tonnes of pangolin scales seized at Kwai Chung Customhouse Cargo Examination Compound, China	23rd Jun 2016	S	EIA database[11]
Seizure of 7,300 kg of pangolin scales, Hong Kong	19th Jul 2016	S	EIA database[11] **[FB]**
Celebrities and leaders in WildAid campaign in Vietnam	29th Jul 2016	M	www.wildaid.org/news

Event	Date/Year	Type	Source [media/interest peak, shown for 2015–2016]
IUCN Resolution supporting pangolin conservation[9]	31st Aug 2016	G/IG	www.ifaw.org/united-kingdom; portals.iucn.org/library
Jane Goodall hosts reception at IUCN World Conservation Congress supporting pangolin conservation	2nd Sept 2016	M	www.facebook.com/janegoodall/videos/10154509286492171/
Episode of Black Market: Dispatches on US TV investigates pangolin poaching	13th Sept 2016	M	www.vice.com; a YouTube clip of this episode 'The most trafficked mammal on the planet' also published online on the same day (34K views)
WildAid report (Pangolins on the Brink) released	21st Sept 2016	NG	www.wildaid.org/news/pangolins-brink
'Baba' dies at San Diego Zoo	28th Sept 2016	O	www.sandiegouniontribune.com/news
CITES Appendix I listing for all pangolin species	28th Sept 2016	G/IG	newsroom.wcs.org/News-Releases/articleType/ArticleView/articleId/9303/CITES-CoP17-Victory-Today-for-Pangolins.aspx; www.cites.org/eng/app/appendices.php **[N, FB, wGT]**
YouTube Wildest Animal Rescues video 'Saving Vietnam's Critically Endangered Pangolin' published (50K views)	5th Oct 2016	M	www.youtube.com (uploaded by Barcroft Animals)
Pangolin trade photo wins the Wildlife Photographer of the Year Photojournalist (single image) award	18th Oct 2016	M	www.nhm.ac.uk/visit/wpy/gallery/2016/images; **[FB, wGT]**
National Geographic short film (The Tragic Tale of a pangolin)	13th Nov 2016	M	www.video.nationalgeographic.com/video/short-film-showcase/the-tragic-tale-of-a-pangolin-the-worlds-most-trafficked-animal
3.1 tonnes of pangolin scales seized in Shanghai, China[10]	10th Dec 2016	S	EIA database[11] **[possibly associated with peaks in news and weekly GT on 28th Dec, see text]**

[1] Baba, an African while-bellied tree pangolin, was brought to the zoo after being intercepted by Fish and Wildlife officials in an illegal shipment, he was kept in the Children's Zoo as an ambassador for the species.

[2] Jointly organised by Wildlife Reserves Singapore and TRAFFIC SE Asia.

[3] CITES secretariat issued Alert No. 37 on fraudulent and illegal trade in pangolins.

[4] Countries across Southeast Asia took part in the largest coordinated operation against the illegal poaching and trade in pangolins. Operation Libra, coordinated by INTERPOL's Environmental Crime Programme, involved investigations and enforcement actions across Indonesia, Laos, Malaysia, Thailand and Vietnam. Supported by the Freeland Foundation through a grant from USAID, the operation led to the arrest of more than 40 individuals, with some 200 additional cases under investigation across the region.

[5] Free, week-long tournament 'Roll with the pangolins' featured in the online game Angry Birds Friends, endorsed by Prince William in his role as President of United for Wildlife.

[6] Commissioned by the environmental NGO Nature for Education Vietnam.

[7] Organised by a local NGO (1StopBruneiWildlife) and a member of the PSG.

[8] This means that it is acknowledged that legal protection may be warranted based on the evidence presented in the petition, a status review is then initiated to determine whether petition actions are warranted.

[9] Resolution/recommendation number WCC-2016-Res-015, original motion number 011: Greater protection needed for all pangolin species.

[10] Widely reported as the largest pangolin seizure in China at that time (e.g. www.phys.org/news/2016-12-china-biggest-ever-pangolin-scale-seizure.html) although there were two larger seizures in Hong Kong earlier in the Year (see Table).

[11] Pangolin Crime Dataset 2000-2017 (a dataset of poaching and seizure incidents derived from publically available sources primarily in Chinese and English languages) held by the Environmental Investigation Agency UK, (eia-international.org/illegal-trade-seizures-pangolins).

* Note that World Pangolin Day was initiated by NGOs, and, as such is categorised as an NGO event, but could now be considered to be a media event.

The EIA database contained records of a total of 712 pangolin seizures between 2005 and 2016, of which sixteen seizures fitted our definition of a major seizure event. The first major seizure occurred in 2005, followed, in 2008, by two and, from 2010, one or two per year (except 2014 when there was none documented) and three in both 2015 and 2016 (see Table 1 for details). Major seizures occurred in China (7), Vietnam (3), Indonesia (3), Malaysia (1) and the Philippines (1, with one regional event across Southeast Asia coordinated by INTERPOL's Environmental Crime Programme, Table 1).

Trends in social and editorial media, 2005–2016

Our search revealed 6,244 FB posts on 'pangolin wildlife trade' and 1,445 news articles on pangolins, between 2005 and 2016. FB posts were posted by 3,768 unique posters that, together, elicited 22,698 comments, 89,077 'shares' and 371,785 'likes'. There was a clear and dramatic increase in both posting and response to posts over time, with fewer than 10 posts per year (and < 30 comments, < 20 likes) in 2008 and 2009 (there was none prior to 2008), increasing to over 200 (with over 1,000 comments and over 2,000 likes) in 2012 and reaching more than 4,000 (with 11,329 comments and 246,556 likes) in 2016 (Fig. 1, Suppl. material S1). Accounting for the increase in FB users over this time period, this amounted to an almost 100-fold increase in FB activity between 2009 and 2016 and a relative 55-fold increase in the number of 'new' posters posting about pangolin trade (see S1). The number of news articles showed similar, but less dramatic increases, with an overall nine-fold increase from 30–50 articles per year between 2005 and 2010, to > 100 articles in 2012 and > 400 articles in 2016 (Fig. 1, Suppl. material S2).

Peaks in public interest and co-occurrence with events, 2005–2016

Monthly google searches for 'pangolins' increased (albeit at a relatively minor rate: slope = 0.18, $p < 0.001$) between 2005 and 2016, with the first apparent increase (change in slope) occurring in February 2012 (Fig. 2a), corresponding with the reformation of the IUCN PSG and the first World Pangolin Day. Variability increased over time but one peak in the data, occurring in April 2015, was almost twice that of any others (Fig. 2a). Eight additional monthly peaks were identified at: May and November 2007, May 2012, April 2013, April 2014, November 2015, August 2016 and October 2016 (Fig. 2a). The pattern in monthly Wikipedia page views, in 2016 and the latter half of 2015, broadly matched that shown by GT (Fig. 2a). During this time period, the number of views of the Wikipedia pangolin page ranged between 1,075 and 52,869 per day with the highest volume of searches occurring on the 26th and 27th August 2016 (52,869 and 44,595, respectively, compared with a daily average of 3,222).

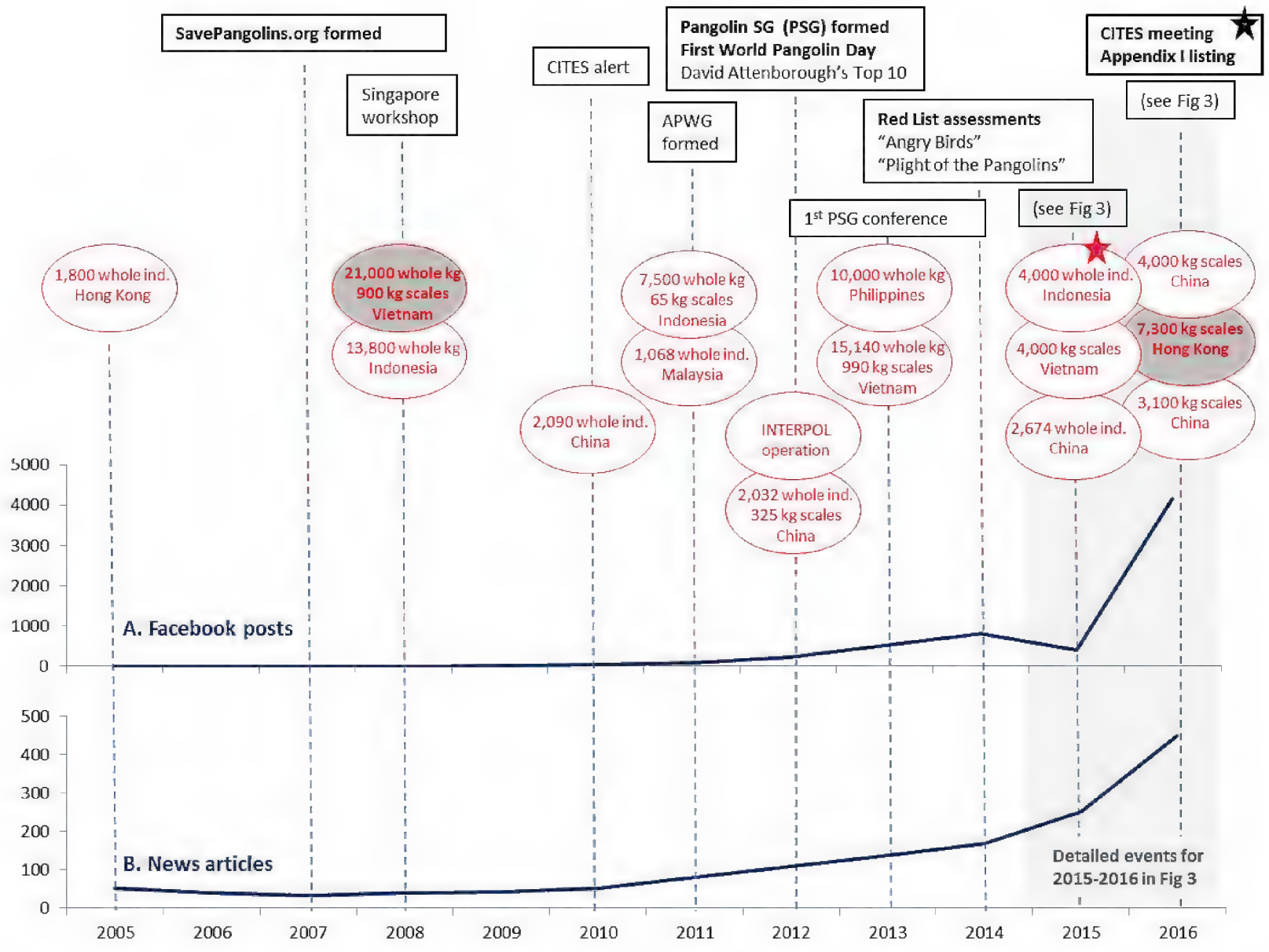

Figure 1. Annual trends in the number of **A** Facebook (FB) posts (n = 6,244) and **B** news articles (n = 1,445), related to pangolin trade (FB) and pangolins (news), respectively, between 2005 and 2016, shown against events (top), including 'major seizures' (defined as in text, where 'ind.' refers to the number of pangolins recorded, otherwise the weight of pangolins recorded). The shaded circles mark the largest seizures of whole pangolins and pangolin scales, respectively, recorded in the EIA database for the period of the study. The red star marks the Medan seizure in Indonesia in April 2015, referred to in the text; the black star marks the Appendix I listing of all pangolin species at the CITES CoP 17 meeting in September 2016.

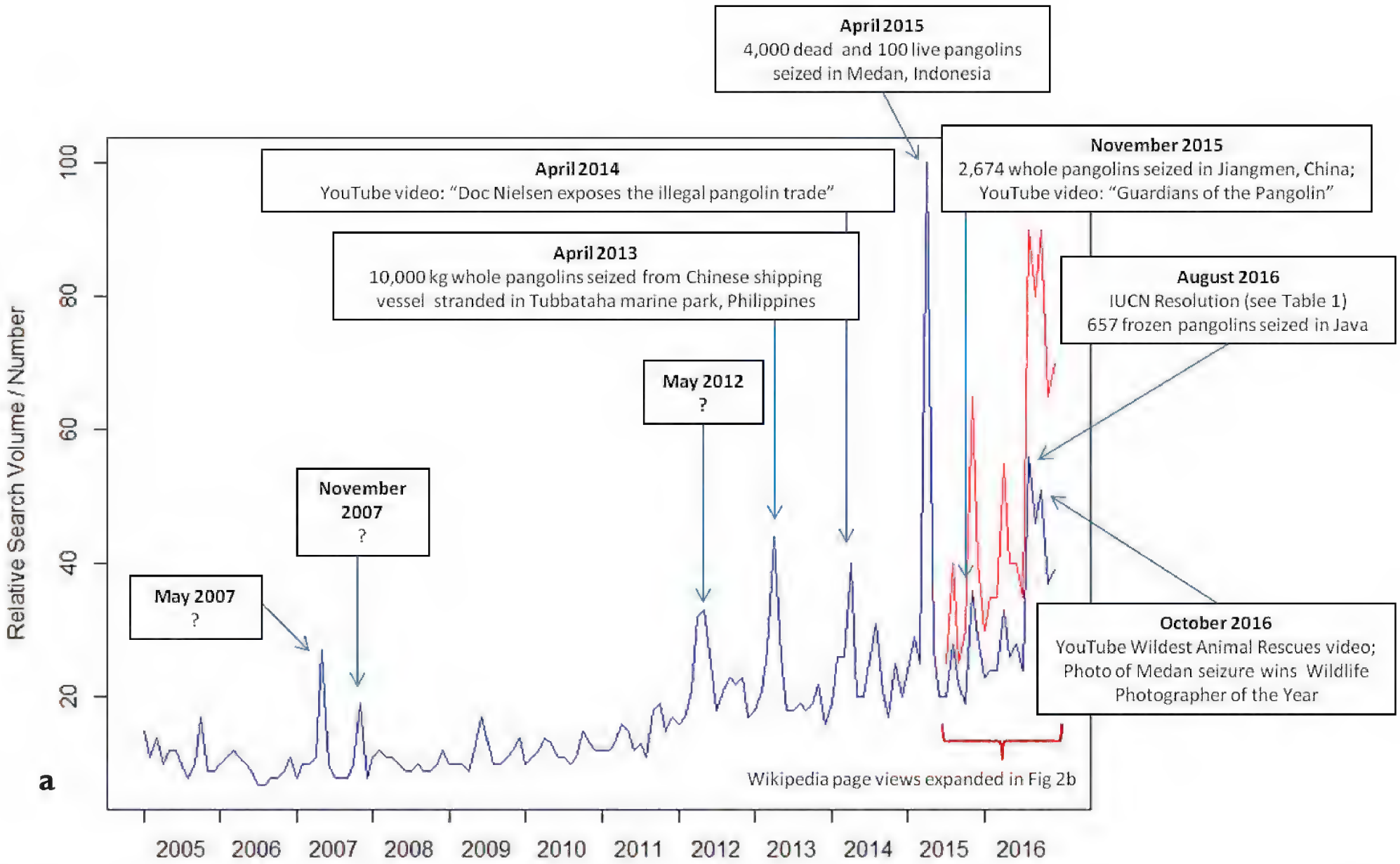

Figure 2a. Monthly Google Trends (GT) search volume (blue) shown against number of Wikipedia page views (red), 2005–2016. Note that GT shows relative search volume, where 100 represents the peak and all other values are relative to the peak; two breakpoints in the data were identified (at February 2012 and March 2015). Text boxes show events that co-occurred with peaks in GT search volume (see Table 1 and text for details); peaks that did not appear to correspond with an event are marked with a '?'. GT peaks were identified as statistical outliers in time series data (see text)

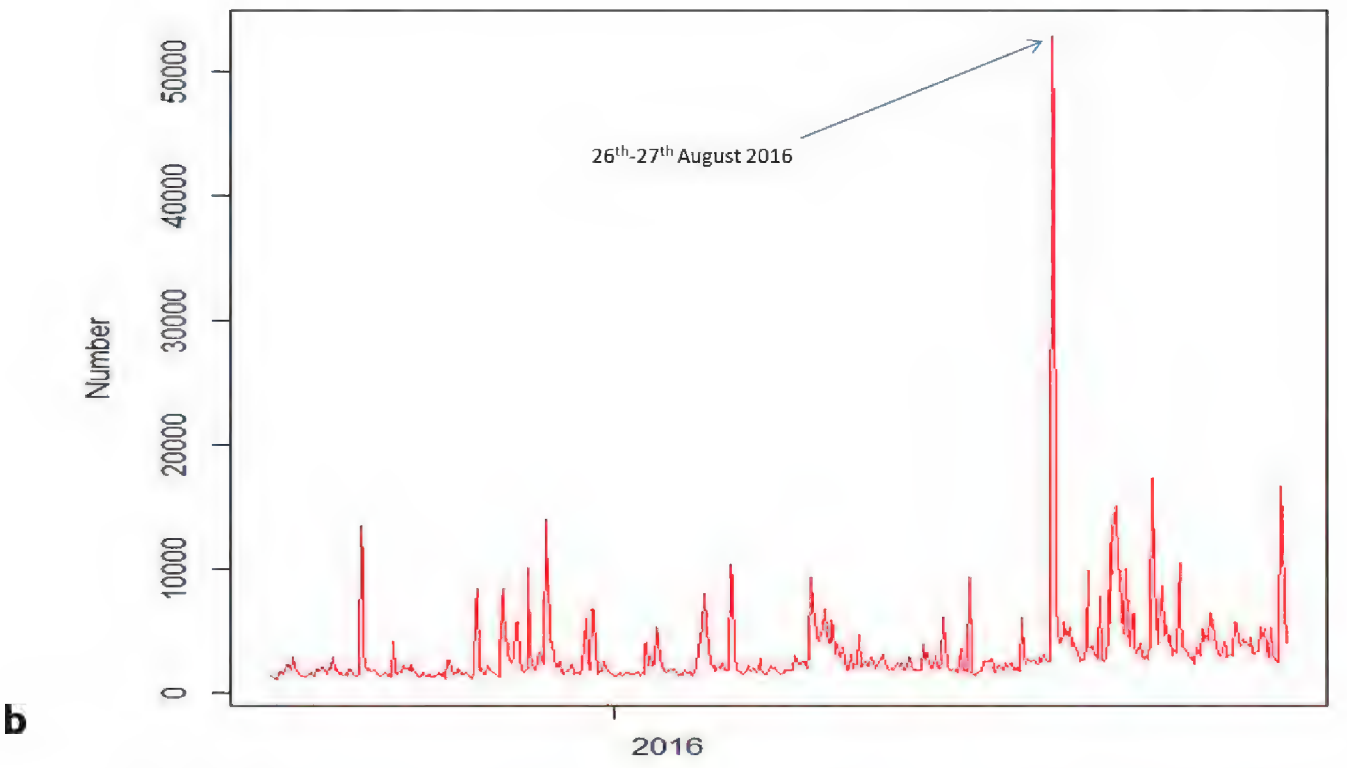

Figure 2b. Daily Wikipedia page views for July 2015 – December 2016 illustrate occurrence of the single two day peak in August 2016 that co-occurred with the seizure of 657 frozen pangolins in Java (see text).

The April 2015 GT peak may have been associated with the Medan warehouse seizure in Indonesia (where 100 live and an estimated 4,000 dead pangolins were found, Table 1) that occurred in the same month. With the exception of the August 2016 peak, all other GT peaks occurring from and including 2013, occurred in the same month as either a major seizure or the release of a YouTube video identified as an event (see Fig. 2a, Table 1). The August 2016 GT peak coincided with various pre-CITES CoP 17 meeting activities but the Wikipedia page views peak suggests that the peak in public interest at this time actually occurred on the 26th August (2016)(Fig. 2b) coinciding with news reports of a seizure of 657 whole frozen pangolins in a freezer in Java by Indonesian authorities (Pangolin Crime Dataset 2000–2017; see Methods). The Javan seizure was not identified as a major seizure but both the Javan and the Medan seizure were associated with graphic images (a large pit full of thousands of dead pangolins and pangolins wrapped in freezer bags, respectively) published in the Guardian newspaper (The Guardian 2015, 2016). The Medan photograph won the Natural History Museum Wildlife Photographer of the Year (www.nhm.ac.uk/visit/wpy.html) photojournalist award in October 2016 (see Table 1), which was announced on the 18th October 2016 and perhaps linked with the October 2016 GT peak (Fig. 2a) and the minor peak in Wikipedia page views seen on the 19th October 2016 (Fig. 2b). The three monthly GT peaks prior to 2013 did not appear to correspond with identified events.

Correlations and associations amongst peaks in editorial and social media, public interest and events, 2015–2016

We identified 29 individual daily peaks in FB posts, 16 in news articles and five weekly peaks in GT (Fig. 3; for comparison with monthly peaks shown in Fig. 2a, weekly GT

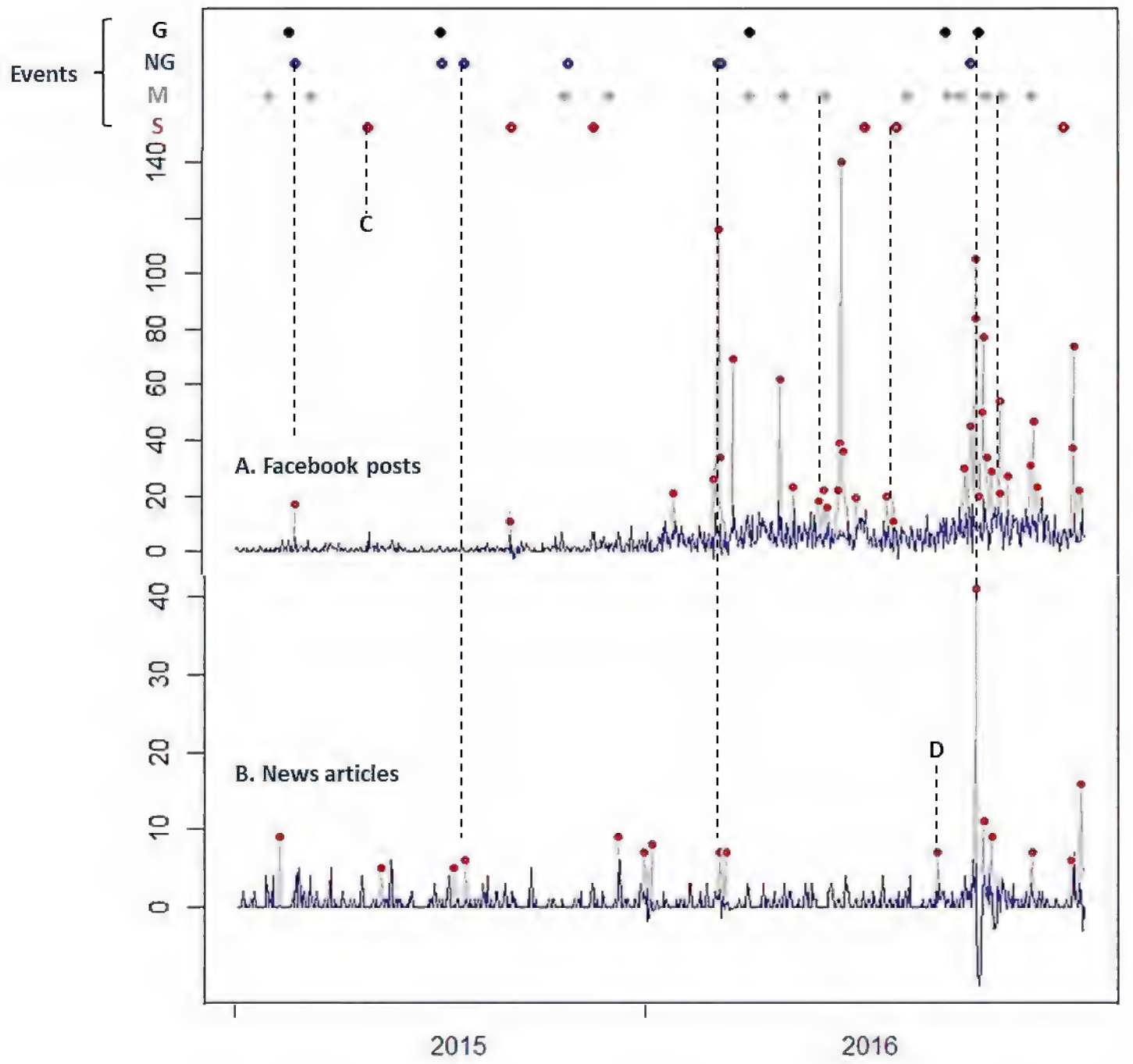

Figure 3. Daily trends in **A** the number of Faceook (FB) posts and **B** the number of news articles, showing peaks in activity (red circles) against the occurrence of events (top), 2015–2016. G=governmental event, NG=non-governmental event, M=media event or 'other', S='major seizure'; for details of events see Table 1. Peaks in FB posts/news articles were identified as statistical outliers in time series data (see text; note that all positive outliers are shown in A but only 29 of these occurred on non-consecutive days and were thus counted as peaks in activity). C marks the Medan seizure associated with a peak in weekly GT (not shown); D marks the Javan seizure that was not identified as an event but corresponded with a peak in news articles (shown) and weekly GT (not shown) (both seizures are referred to in the text).

peaks occurred in April 2015 and August, September, October and December 2016). There were statistically significant but very weak cross correlations between news article peaks and FB post peaks at zero time lag (CCF=0.139), -7 days (CCF=0.141) and +4 days (CCF=0.139): peaks in news articles and FB posts coincided (on the same day) on four occasions, there were six occasions on which peaks in FB posts were preceded by a peak in news (by between one and seven days) and five on which the opposite was true (by between one and four days). Approximately half of all peaks in both news articles and FB posts (n= 8 and n=15, respectively) occurred in the absence of the other (within

a seven day period, Fig. 3). Direct (same day) correspondence of peaks in media interest with events was similarly rare, but equally (un)likely for editorial and social media (Fisher's exact test, p=1.0) occurring on only four occasions for news peaks (25% of news peaks) and six for FB peaks (21%) (including three occasions on which both peaked simultaneously). Eight (50%) news peaks and 13 (45%) FB peaks occurred within seven days of an event. It was not possible to test formally for cross correlations between GT and either FB posts or news articles or between GT and events, because they were measured at different time scales but comparing dates, identified as peaks, revealed that correspondence between GT and media peaks was similarly inconsistent: GT peaks encompassed daily peaks in news articles once, FB posts once, both twice and neither once. Three of the five weekly GT peaks overlapped with events; another weekly GT peak overlapped with the (non-major) Javan seizure as identified in Fig. 2a (which also corresponded directly with a peak in news) and the fifth may have been associated with a seizure but with a 19-day time lag (see below).

There were statistically significant but weak, or very weak, cross correlations between news article peaks and events (at zero time lag [CCF=0.161] and – 7 days [CCF=0.209]) and between FB post peaks and events (at zero time lag [CCF=0.148]). Overall, only eight of the 32 events occurring in 2015–2016 corresponded directly with peaks in either social or editorial media or public interest (see Table 1, Fig. 3). These eight peak-associated events included all event types (one inter-governmental event [the CITES meeting], one official non-governmental event [the USFWS/ESA petition], two that could be considered as non-governmental-media events [the two World Pangolin Days], two media events [a celebrity-supported 'say no to pangolin products' campaign in China and a pangolin trade photo winning an award in the Wildlife Photographer of the Year competition] and two major seizures of pangolin scales, see Table 1 for details). Combining social and editorial media and public interest, there was no significant association between type of event (categorised as governmental/inter-governmental [G/IG], non-governmental/media [NG/M] combined and major seizures [S]) and the occurrence of a peak response (χ^2 = 0.305, df=2, p=0.859). Sample size was too small to test for differences in co-occurrence with event type amongst media type and public interest, but post hoc checks of collated news articles and FB posts for the week during which an event occurred (for all events listed in Table 1, 2015–2016), suggested that coverage rather than activity peaks (i.e. whether or not an event was mentioned that week) differed between editorial and social media with news articles most likely to cover governmental events and least likely to cover media events (χ2 = 13.93, p=0.001), while FB posts were equally likely to cover events of all types (χ2 = 4.44, p=0.218).

We identified four dates at which level shifts occurred in the number of FB posts and two at which level shifts occurred in the number of news articles (Fig. 3; no level shift outliers were detected for GT data). Whilst not necessarily causative, level shifts marked a point in the time series at which there was an overall increase in baseline media activity (number of news articles or of FB posts). Predictably, two of the dates identified (in the FB time series) corresponded with the 2016 World Pangolin Day

and the CITES meeting on 28 September 2016. For the news time series, a level shift on 26 September 2016 corresponded with a peak in news articles two days later and appeared to be due to articles covering the lead up to the CITES meeting (on the 28th). The two additional level shifts in the FB time series occurred on the 21st December 2016 (associated with an open letter to the Chinese ambassador in Namibia raising the issue of Chinese nationals involved in commercial wildlife crime in Namibia that was widely shared through social media, Brown 2016) and the 5th June 2016 (World Environment Day, with the theme 'Zero tolerance for illegal wildlife trade'). The second level shift in news articles occurred on 28 December 2016, associated with what was widely reported (at the time) to be the 'biggest ever scale seizure", in China on the 10th December (18 days earlier) in Shanghai, China (and co-occurring with a weekly peak in GT, see Fig. 3, Table 1).

Discussion

Between 2005 and 2016, alongside intensified efforts by NGOs, governments and scientists, interest in pangolins and in the threats posed by the international trade in their meat and scales, has undergone a significant increase in the editorial and social media and amongst global western audiences. In addition to underlying increasing trends, time series describing editorial and social media activity and GT were characterised by considerable fluctuations and clear peaks in activity. Whilst it was difficult to detect generalisable patterns for peaks in activity amongst datasets or between datasets and external events and bearing in mind that co-occurrence does not necessarily imply causation, our exploratory analysis revealed a number of potentially insightful observations.

First, although only a quarter of events were associated with a peak in either social or editorial media or public interest, there was no evidence that any particular type of event was more likely to generate a significant response than any other. This suggests that all types of events may have a role to play in increasing the public profile of conservation issues. Certainly, there are reasons for combining different types of events – for example, whilst conservation-themed 'big screen' animations can trigger considerable interest across a broad viewership, Yong et al. (2011) suggested that they are more effective when combined with supporting educational materials and campaigns.

For major seizures specifically, co-occurrence with peaks in media activity was low but 'different' seizures (see below) were associated with peaks in public interest and there was some evidence of time delays in media response. The only major seizure (of six recorded from 2015–2016) that co-occurred directly with a media peak (FB posts) was the largest scale seizure (7.3 tonnes) recorded in the EIA database at the time of this study; another, that appeared to be associated with a news peak with an 18-day time lag, involved 3.1 tonnes of pangolin scales but was widely reported in the news to be 'China's biggest ever pangolin scale seizure' (see Table 1, 19 July and 10 December 2016, respectively). Between 2010 and 2015, there was a global increase in the weight of pangolin scale seizures and an increase in the proportion of large-quantity shipments

of scales (Heinrich et al. 2017) and it is intuitive that successively larger seizures would continue to attract media attention, as each is reported to be 'the largest ever' (see e.g. AFP 2016). There has been no such increase in the size of seizures of whole pangolins (Heinrich et al. 2017), but peaks in public interest (at either weekly or monthly resolution) appeared to be associated with seizures of whole pangolins (alive or dead) and sometimes with seizures of whole pangolins that did not meet our *a priori* definition of a major seizure (see Table 1, Figs 2, 3). Although sample size was small, this suggests that seizures of whole pangolins attract attention amongst the general public (regardless of the numbers involved) and/or that there are other features of whole pangolin seizures that attract attention. With respect to the latter, we suspect that accompanying 'shocking' images (such as in the Medan warehouse raid; The Guardian 2015) may be key (see also Pinholster and Ham 2013; Papworth et al. 2015; Wu et al. 2018).

Second, only a quarter of the peaks in either social or editorial media activity clearly corresponded with an event. News articles and FB posts partly reflect public interest (e.g. Phillis et al. 2013), but news can also be agenda-driven (Papworth et al. 2015) and repeat-posters on FB, in this study, were predominantly professional or semi-professional organisations rather than individuals (see Suppl. material S1). Social and editorial media activity, thus, reflect the combined extent of scientific communication and advocacy, in addition to public response and are presumably driven by several factors, which may include, for example, organisational planning and schedules not necessarily related to external events. In contrast and notwithstanding differences in resolution, there was some evidence of slightly higher correspondence with events for GT. GT does not provide information on the opinion or motives of the interested public (Proulx et al. 2014), but it is considered a 'valid tracker of public curiosity [sic]' (Mccallum and Bury 2013). In this case, the relatively high correspondence between GT peaks and events (at least five of nine monthly GT peaks and at least three of five weekly GT peaks, see Fig. 2 and Table 1), together with an apparent association with seizures, highlights the importance of the news coverage of these types of incidents in raising awareness (see also Bolsen 2011, who found that news itself was driven more by real-world events than by messages supplied by advocacy groups or governments seeking to influence public discourse).

Third, whilst peaks in FB activity and news articles sometimes co-occurred, most often they did not. Co-occurrence between peaks in social and editorial media was sometimes, but not always, associated with a time lag of between one and seven days – but, whilst peaks in news articles sometimes appeared to lead peaks in social media, social media peaks preceded news peaks on an almost equal number of occasions. These apparently inconsistent observations presumably reflect the dual function of social media in both relaying news in the traditional editorial media (with some time lag) and creating news (Copeland 2011), as well as underlying differences in the types of events covered by editorial versus social media. Timing of peaks in public interest, similarly, differed from that of peaks in either news or social media activity, but overlapped (within the week in which GT data were collated) on different occasions with both. Social media is widely used as a news source (a recent YouGov survey found that over half of

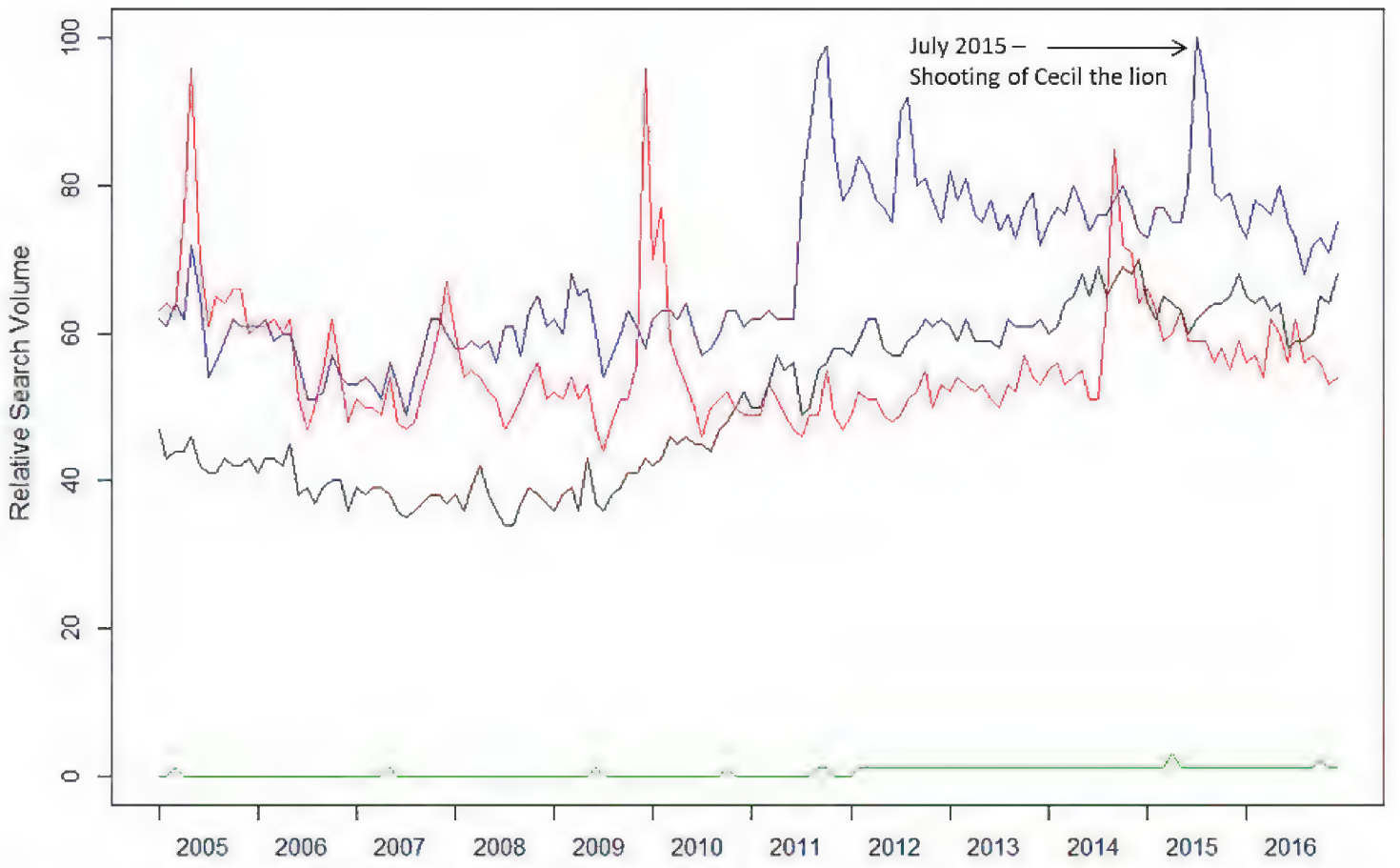

Figure 4. Google Trends (GT) for pangolins (green) compared with three large, well-known, 'charismatic' species – tigers (red), elephants (black) and lions (blue), 2005–2016. Data shown are relative search volume, where 100 represents the peak and all other values, for all species, are relative to the peak. Note the very low search volume for pangolins, relative to the other species; the highest relative search volume occurs in July 2015, coinciding with the shooting of Cecil the lion (Macdonald et al. 2016, see text).

respondents from 36 countries get their news from social media sites; YouGov 2017), but editorial media still clearly has a role, independently of, and as a driver of, social media. Further, whilst social media peaks through 2016 were ten times in magnitude that of editorial media peaks over the same period, these extreme peaks in social media activity were not seen until 2016; whereas smaller, more frequent peaks in editorial media were seen throughout 2015 (Fig. 3), suggesting that social media activity, more generally, may, at least in part, have been a response to persistent news coverage. That public interest peaks independently of peaks in the media (but responds to events covered in the media) suggests that media content is more influential than the number of articles or posts produced (this is probably also true of FB posts posted in response to news articles).

In accordance with other studies of media attention surrounding high-profile events (e.g. the 'climategate' media event, Anderegg and Goldsmith 2014; and the shooting of Cecil the lion, Macdonald et al. 2016), the vast majority of peaks identified in media activity and were transient and, in this study, in most cases, had returned to former levels within a few days (GT could not be assessed at time scales less than a week). This short-lived nature observed in public interest is common (Downs 2018) and unsurprising since media coverage of events tends to be ephemeral (e.g. Sampei and Aoyagi-Usui 2009). There was some evidence of sustained higher levels of media

activity following World Pangolin Day 2016 and the CITES CoP 17 meeting (also in 2016), but the gradual increase in public interest (as evidenced by GT) was not clearly related to any particular event.

Finally, it is noteworthy that, relative to other species, public interest in pangolins was still relatively low. GT for pangolins, relative to for example tigers, elephants or lions, were small (Fig. 4) and there was no evidence that any of the FB posts or YouTube videos described in key events, went viral (the precise definition of 'viral' is complex but usually involves > 1 million 'likes', comments and 'shares' or views, Rayson 2017). Maximum 'likes' and 'shares' recorded in this study for any one FB post were 36,000 and 3,500 (Suppl. material S1), respectively and the maximum views of any one YouTube video 34,000 (see Table 1).

Limitations

As many of the seizure records in the EIA database were originally sourced from news articles, news articles and seizures were not entirely independent. Social media activity was based only on FB and on English language search terms. It is likely that a proportion of global social media activity was carried out in different languages and on alternative platforms, particularly WeChat or Weibo (prominent social media platforms in China). Data resolution may also have been too coarse to disentangle the order of events insofar as news reports, available first thing in the morning, may generate social media reaction throughout the day (but on a daily basis appear to be simultaneous). These limitations require some caution in interpretation of our findings; nevertheless, our data explorations offer some useful insights into the apparent response of the media and the general public to different events and the differences and similarities amongst them.

Conclusions

The CITES Appendix I listing for pangolins and the trade ban were an important legal step. That there has been considerable global activity and attention directed at pangolins both proceeding and in response to this event is clear. However, seizures of ever increasing size continue to be reported – during the writing of this paper, 11.9 tonnes of pangolin scales were seized in Shenzhen, Hong Kong, on the 29th November 2017 (IFAW 2017; this is larger than any of the seizures included in this analysis and represents the largest seizure yet reported). Efforts are now needed to translate the ban and associated enforcement into effective action and behaviour change on the ground (Challender and MacMillen 2014; Challender et al. 2015).

Insofar as public awareness can help drive these efforts, social media clearly can have considerable reach, but traditional editorial media is also needed and the two are not necessarily directly linked. Continued widespread coverage and reporting of pangolin seizures is probably paramount. The unpredictable nature of events (in terms

of generating attention, remembering that not all events were specifically designed to raise awareness) raises a number of questions that warrant further study. For example, what is it about a conservation- or trade-related social media post that makes readers want, or feel the need to, share it? In the case that news leads social media, what influences journalists? How (via what media and what networks?) should the public be informed of inter-governmental and governmental actions? How influential (positive or negative) are celebrities (e.g. Duthie et al. 2017)? How important are powerful images (e.g. Wu et al. 2018)? These types of questions have relevance beyond pangolins (see e.g. Pearson et al. 2016; Wu et al. 2018), but high profile issues that have evolved over time (in terms of media and public interest), such as pangolin trade, will likely offer useful case studies.

Online science communication is complex. Propagation of messages, for example, depends on the susceptibility (as well as the influence) of individual members of social networks (Aral and Walker 2012) and comments (and the dynamics of online communication) can have a greater influence on a persons' perception of a post or article than the content itself (Brossard and Scheufele 2013). We found (Suppl. material S1) that most (> 90%) social media posts actually attracted little attention (< 100 'likes', < 10 comments) and that over 80% were unlikely to be 'shared'; it may be that message spread is determined almost entirely by the poster (and the size of their social network) rather than by the actual content of the post (the 'Kardashian effect', see e.g. Hall 2014). Many of these ideas could be explored experimentally in a wildlife protection context and, in the current emerging field of conservation marketing (Wright et al. 2015; Verissimo and McKinley 2016), these types of studies will be increasingly relevant.

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Supplementary material 1

Facebook posts

Authors: Lauren A. Harrington, Neil D'Cruze, David W. Macdonald

Data type: social media data

Explanation note: Posters, date and number of comments, likes and shares, for all Facebook posts, 2005–2016, under the search term 'pangolin wildlife trade' (note that the first post on 'pangolin wildlife trade' was posted in 2008).

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Link: https://doi.org/10.3897/natureconservation.30.28651.suppl1

Supplementary material 2

News articles. Complete text of all news articles retrieved from Nexis UK under the search term 'pangolin', January 2005 – December 2016

Authors: Lauren A. Harrington, Neil D'Cruze, David W. Macdonald

Data type: social media data

Copyright notice: This dataset is made available under the Open Database License (http://opendatacommons.org/licenses/odbl/1.0/). The Open Database License (ODbL) is a license agreement intended to allow users to freely share, modify, and use this Dataset while maintaining this same freedom for others, provided that the original source and author(s) are credited.

Link: https://doi.org/10.3897/natureconservation.30.28651.suppl2

Supplementary material 3

Collated datasets

Authors: Lauren A. Harrington, Neil D'Cruze, David W. Macdonald

Data type: measurement

Explanation note: Annual Facebook posts and news articles, 2005–2016; monthly Google Trends, 2005–2016 (including daily Wikipedia July 2015 – December 2016); weekly Google Trends, 2015–2016; daily Facebook posts and news articles, 2015–2016.

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